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Original Communication

Pattern of craniofacial injuries in patients admitted to Tanta University Hospital – Egypt

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ABSTRACT

The goal of this work was to determine the craniofacial injury patterns in hospitalized patients to facilitate the awareness, by identifying, describing and quantifying trauma for use in planning and evaluation of preventive programs. Two-hundred and fifty five patients with craniofacial injuries were registered at the department of neurosurgery in Tanta University Hospital. Data were collected including age, gender, medical history, cause of injury and type of injury, location and frequency of soft tissue injuries, skull fractures, facial bone fractures, brain injuries and concomitant injuries, patient symptoms, clinical signs and the radiological findings. The most common causes of craniofacial injuries were road traffic accidents, followed by activity of daily life and assaults. Gender distribution showed that, males were at higher risk than females with a ratio of 5.5/1. In total of skull fractures, 47.84% were fissure fracture and 24.31% were depressed fractures. In total of brain injuries, 7.06% for concussion, 4.71% for contusion, 10.98% for brain laceration, 14.12% for pneumocephalus and 36.47% for brain edema. Regression analysis revealed increased risk for skull fractures and brain injuries in traffic accidents were 84.78%, 94.20%, respectively, and 59.14%, 50.54% in activity of daily life, but the probability of soft tissue injuries increase in traffic accident and violence.

1. Introduction

Trauma remains one of the principal causes of mortality in the western world, especially among young adults.[1] Craniofacial injuries are the most common trauma affecting a significant proportion of patients, they can occur in isolation or in combination with other serious injuries including cranial, spinal, upper and lower body injuries. The epidemiology of craniofacial injuries varies in type, severity and cause depending on the population studied.[2] Additionally, the success of treatment and implementation of preventive measures are more specifically dependent on epidemiological assessments.[3]

Unnoticed complex craniofacial and skull base fracture, cerebrospinal fluid fistulae and cranial nerve injuries can result in blindness, diplopia, deafness, facial paralysis or meningitis. Early recognition of specific craniofacial and skull base injury pattern can lead to identification of associated injuries and assist in establishing clinical and research priorities for effective treatment and prevention of these injuries.[4] However, despite injury improvement, subtle complex facial fracture with cerebrospinal fluid leaks, temporal bone fracture and cranial nerve injuries can remain undiagnosed. Unfortunately, delayed or missed diagnosis can lead to significant morbidity or death. Greater awareness of potential cranial injuries is needed to facilitate more rapid diagnosis and appropriate treatment.[5]

Although much is known about the epidemiology of craniofacial injuries, little is known about national injury patterns and outcomes. So the aim of this work was to determine the craniofacial injury patterns in hospitalized patients in Tanta University to analyze the outcomes of craniofacial injuries and to highlight the underlying principles and formulate treatment guidelines by identifying, describing and quantifying trauma for use in planning and evaluation of preventive programs. Furthermore, this study assesses the statistical pattern of craniofacial injuries in relation to different causes including the use of logistic regression analyses.

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1.2. Subjects and methods

Two-hundred and fifty five patients with craniofacial injuries were registered at the department of neurosurgery in Tanta University Hospital. Data were collected including medical history, patient symptoms, clinical signs and the radiological findings. A systematic method was used for the clinical examination of the traumatized craniofacial region. Data of patients were recorded including cause and location of injury, frequency and type of injury (frequency of soft tissue injuries, facial bone fractures and concomitant injuries), as well as age and gender distribution. Furthermore an optimal combination of radiographic imaging was ascertained and computed tomography (CT) was found to be the single most informative mode of imaging. Duration of recovery and associated complications were also recorded.

Craniofacial injuries were classified into; soft tissue injuries, skull fractures and intracerebral injuries. Soft tissue injuries were classified into abrasion, contusion and laceration. Skull fractures were classified into; fissure and depressed fractures. The clinical examination of craniofacial skeleton begins with inspection for localized tenderness, numbness, bleeding, asymmetry, deformity, ecchymosis, periorbital edema, otorrhea and rhinorrhea.

The Glasgow Coma Scale was used to assess the severity of brain injury. A conservative or operative intervention done for all the cases was also recorded. Statistical analyses performed included descriptive analysis, chi square test, Fisher's exact test, and Mann–Whitney's *U* test. This was followed by logistic regression analyses to determine the impact of the main causes of craniofacial injuries. The SPSS Version 11.0 (SPSS Inc., Chicago, IL) and Epi Info™ Version 3.5 were used for statistical analyses.

2. Results

2.1. Age distribution

The age of patients at time ranged from 11 months to 63 years with a mean of 22.72 ± 16.78 years, 37.64% of the patients were less than 10 years, 17.64% were in the second decade, 21.18% were in the third decade, 5.88% were in the fourth decade and 8.23% were in the fifth decade, while 9.41% were older than 50 years. 69.41% of injuries were outside but 30.59% were at home, 62.35% of the patients were from urban residence, while 37.65% were rural (Tables 1–3).

The age distribution of patients showed decreasing rates of car accidents every decade of life as presented in Fig. 1 Except in the third and sixth decades of life as the percentage increased to 28.26% and 13.77%, respectively.

Fig. 1 illustrated that accidents from activities of daily life were dominated in the first decade of life, its rate decreased with age but becoming the prevailing cause in the fifth decade. Craniofacial injuries resulting from assaults were most prevalent in the third decade of life.

Table 1
Age distribution of studied patients in years.

Age in years	No. of patients	%
0–10	96	37.64
11–20	45	17.64
21–30	54	21.18
31–40	15	5.88
41–50	21	8.23
>50	24	9.41
Total	255	100

Table 2
Distribution of studied patients according to place of injuries.

Place	No.	%
Home	78	30.59
Outside	177	69.41
Total	255	100

Table 3
Distribution of patients according to residence.

Residence	No.	%
Urban	159	62.35
Rural	96	37.65
Total	255	100

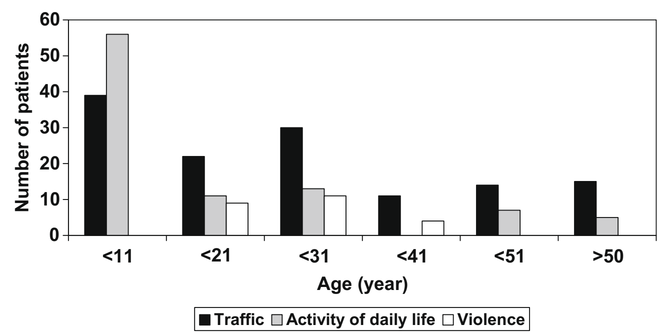

Fig. 1. Distribution of patients according to age and etiology.

Table 4
Distribution of patients according to etiology of trauma and sex.

Etiology	Male		Female		Total	
	No.	%	No.	%	No.	%
Activity of daily life	75	29.41	18	7.06	93	36.47
Road traffic accident	117	45.88	21	8.24	138	54.12
Violence	24	9.41	0	0	24	9.41
Total	216	84.70	39	15.30	255	100

2.2. Gender distribution

Table 4 showed that, the ratio of men to women was 5.5:1, where men ($n = 216$) compared to women ($n = 39$). Men were at a higher risk than women (Fig. 2) for the first 50 years, with an almost three fold risk of injury to males in second and third decades. However, women had a higher likelihood of injury in the third decade, when comparing the male to female ratios of all age groups.

2.3. Injury type

The most common cause of craniofacial injuries was road traffic accidents (54.12%), followed by activity of daily life (36.47%) and 9.41% for assaults. Males were at higher risk than females, there were 45.88% in road traffic accidents, 29.41% in activity of daily life and 9.41% in violence compared to 7.06%, 8.24% and zero for females, respectively (Table 4).

The prevalence of all injury types and their combinations in all patients were displayed in Tables 5 and 6. A total of 72.15% had cranial bone fracture either in combination with brain injuries or soft tissue injuries, 32.16% and 38.43%, respectively. 73.33% of

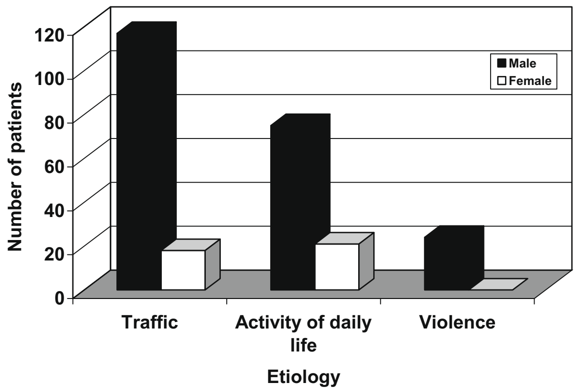

Fig. 2. Distribution of patients according to sex and etiology.

the patients suffered from brain injuries and 75.68% from soft tissue injuries separately. 34.12% of the soft tissue injuries were contusions, 24.71% for both abrasions and lacerations and 23.53% for cut wounds.

Cranial fractures found in the patients of this study were 47.84% fissure fracture (Fig. 3) while depressed fractures (Fig. 4) were 24.31%. As regard intracranial hemorrhages, 33.73% were extradural haematoma (Fig. 5), 5.5% were subdural haematoma (Fig. 6). In total of brain injuries 14.12% were pneumocephalus, 10.98% were brain lacerations, and 7.06% for concussion and 36.47% for brain edema (Table 6). The most frequent combination of injury categories were skull fractures with soft tissue injury followed by skull fractures with brain injury (Table 5).

The initial severity of traumatic brain injury was measured by Glasgow Coma Scale (GCS), they were graded as mild (82.7%), moderate (12.5%) and severe head injury (4.7%). The severity of traumatic brain injury (Table 7) decreased dramatically; the percentage of cases with severe injuries on admission, based on the GCS, dropped in both areas. Of the 187 cases of traumatic brain injury, 61.12% were male, and this proportion did not vary significantly by residence.

The outcomes of the studied patients were analyzed in Tables 8 and 9 as follows; 80% for complete recovery, 17.64% for incomplete recovery, and 2.35% for mortality cases. The major complication in this study was frontal manifestations (behavioral dyscontrol such as mood dysregulation, impulsivity, disinhibition, aggression, attentional and memory deficits) 20% of the complicated cases, followed by facial palsy 17.77%. Upper limb weakness and diminished visual acuity represent 15.55% for each; dysphasia and third nerve palsy were representing 8.8% each, while infection and sixth nerve palsy were representing 6.6% of the complicated cases.

Conservative management was carried out in 107 (41.97%) patients. Surgery was required in 148 (58.04%), 13.3% of which had depressed skull fracture, simple or compound, brain laceration, extradural and subdural haematomas. Patient outcome was assessed according to Glasgow Outcome Scale (GOS) (Table 10).

Table 5
Category of craniofacial injuries in studied patients.

Category of injury	No.	%
Soft tissue lesions	193	75.68
Skull fracture	184	72.16
Brain injuries	187	73.33
Facial bone fracture	43	16.86
Soft tissue and skull fracture	98	38.43
Soft tissue and facial fracture	10	3.92
Skull fracture and brain injuries	82	32.16
Soft tissue, skull fracture and brain injuries	65	25.49

Table 6
Definitive diagnosis of patients with craniofacial injuries.

Type of injuries	No.	%
Cutaneous injuries		
Abrasion	63	24.71
Contusion	87	34.12
Laceration	63	24.71
Cut wound	60	23.53
Skeletal injuries		
Fissure fracture	122	47.84
Depressed fracture	62	24.31
Intracraneal injuries		
Extradural haematoma	86	33.73
Subdural haematoma	14	5.5
Concusion	18	7.06
Barin contusion	12	4.71
Brain laceration	28	10.98
Pneumocephalus	36	14.12
Brain edema	93	36.47

Fig. 3. Plain X-ray showing fissure fracture.

Fig. 4. Plain X-ray showing depressed and fissure fractures.

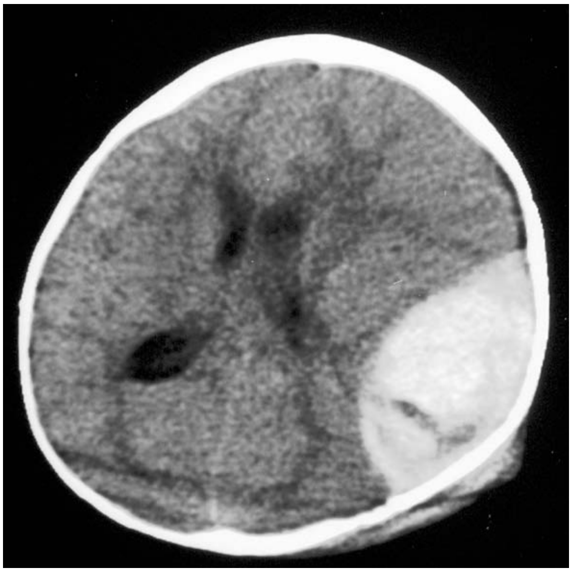

Fig. 5. Computed tomography of skull showing extradural haematoma.

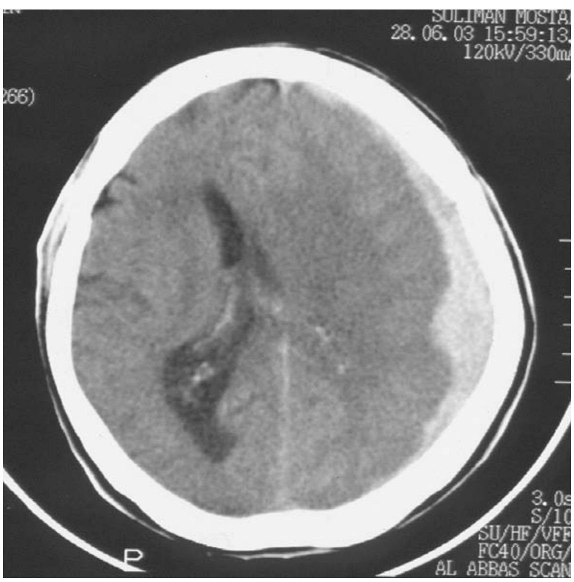

Fig. 6. Computed tomography of skull showing left subdural haematoma.

Table 7
Glasgow Coma Scale (GCS) in patients with craniofacial injuries.

GCS	No.	%
Mild (13–15)	211	82.7
Moderate (9–12)	32	12.5
Severe (3–8)	12	4.7
Total	255	100

Table 8
Distribution of all patients according to outcomes of injuries.

Outcome	No.	%
Complete recovery	204	80
Incomplete recovery	45	17.64
Death	6	2.35
Total	255	100

Table 9
Types of complications in 45 patients.

Complication	No.	%
Infection	3	6.66
Facial palsy	8	17.77
Dysphasia	4	8.88
UL weakness	7	15.55
Frontal manifestations	9	20
Diminished visual acuity	7	15.55
Third nerve palsy	4	8.88
Sixth nerve palsy	3	6.66
Total	45	100

2.4. Regression analysis

The results of regression analysis are reviewed in Tables 11–13 showing highly statistically significant different mean ages of occurrence and injury mechanism for each injury type ($P < 0.001$).

The increased risk of 76.39% for sustaining skull bone fractures existed for males when compared to females (48.72%) at $P < 0.05$. There was an increased risk for skull bone fractures in traffic accidents (84.78%), in contrast, the probability of suffering fractures was lower in activity of daily life (59.14%) at $P < 0.05$ and, in assaults (50.00%) at $P < 0.05$ (Table 11).

Younger patients were at greater risk of soft tissue injuries when compared to older persons ($P < 0.05$) and of 76.92% in females compared with males ($P < 0.05$). In addition, the probability of suffering soft tissue injuries was increased in traffic accidents by 83.33%, in activity of daily life by 32.26%, during assaults by 75% (Table 12).

Furthermore, older people were more prone to brain injuries although no statistically significant differences were found between the sexes for brain injuries ($P > 0.05$). Finally, the probability of suffering brain injuries was raised in traffic accidents by 94.20%, during assaults by 41.67% and in activity of daily life by 50.54% (Table 13).

3. Discussion

Trauma is the leading cause of death in the first 40 years of life. In addition, traumatic injury has been identified as the leading cause of lost productivity, causing more loss of working years than heart disease and cancer combined.[2]

Fractures of the craniofacial skeleton are a common component of multiple traumas resulting from motor vehicle crashes, and industrial accidents, but also from sports, assaults and activity of daily life accidents. Patients sustaining craniofacial fractures present with poorer health outcomes than patients with less severe injuries.[6]

The head is the target of choice in the great majority of assaults involving blunt trauma, the brain and its coverings are vulnerable

Table 10
Medical and surgical interference in the studied cases.

Type of surgical interference	Number	%
Conservative treatment		
Brain edema, contusion and concussion	93	36.5
Extradural haematoma	14	5.5
Surgical interference		
Compound depressed fracture	34	13.3
Compound depressed fracture with brain laceration	28	10.98
Extradural haematoma	72	23.92
Subdural haematoma	14	5.5
Total	255	100

Table 11
Logistic regression analysis. Skull fractures – all accidents ($n = 255$).

Skull fracture ($n = 184$)					
	Yes	No	Odds ratio adjusted	Odds ratio 95% confidence interval	Significance adjusted
Age	31.96 ± 7.56 years	19.67 ± 2.89 years	0.47	0.06–2.88	$P = 0.363$
Sex					
Male	165/216 (76.39%)	51/216 (23.61%)	3.24	2.21–4.75	$P = 0.000$
Female	19/39 (48.72%)	20/39 (51.28%)	0.95	0.41–2.20	$P = 0.896$
Etiology					
Traffic	117/138 (84.78%)	21/138 (15.22%)	5.57	3.22–9.72	$P = 0.000$
Violence	12/24 (50.00%)	12/24 (50.00%)	1.00	0.34–2.98	$P = 1.000$
Activity of life	55/93 (59.14%)	38/93 (40.86%)	1.45	0.85–2.47	$P = 0.149$

Table 12
Logistic regression analysis. Soft tissue injuries-all accidents ($n = 255$).

Soft tissue injuries ($n = 193$)					
	Yes	No	Odds ratio adjusted	Odds ratio 95% confidence interval	Significance adjusted
Age	19.30 ± 12.98 years	15.32 ± 14.37 years	1.48	0.47–4.69	$P = 0.459$
Sex					
Male	163/216 (75.46%)	53/216 (24.54%)	3.08	2.11–4.05	$P = 0.000$
Female	30/39 (76.92%)	9/39 (23.08%)	3.33	1.30–8.73	$P = 0.005$
Etiology					
Traffic	115/138 (83.33%)	23/138 (16.67%)	5.00	2.93–8.57	$P = 0.000$
Violence	18/24 (75.00%)	6/24 (25.00%)	3.00	0.91–10–27	$P = 0.043$
Activity of life	30/93 (32.26%)	63/93 (67.74%)	0.48	0.27–0.83	$P = 0.005$

Table 13
Logistic regression analysis. Brain injuries-all accidents ($n = 255$).

Brain injury ($n = 187$)					
	Yes	No	Odds ratio adjusted	Odds ratio 95% confidence interval	Significance adjusted
Age	36.89 ± 12.89 years	23.92 ± 14.89 years	1.83	0.65–5.15	$P = 0.203$
Sex					
Male	158/216 (73.15%)	58/216 (26.85%)	2.72	1.88–3.95	$P = 0.000$
Female	29/39 (74.36%)	10/39 (25.64%)	2.90	1.16–3.88	$P = 0.012$
Etiology					
Traffic	130/138 (94.20%)	8/138 (5.80%)	16.25	7.36–37.31	$P = 0.000$
Violence	10/24 (41.67%)	14/24 (58.33%)	0.71	0.24–2.14	$P = 0.504$
Activity of life	47/93 (50.54 %)	46/93 (49.46%)	1.02	0.60–1.73	$P = 0.933$

to degrees of blunt trauma that would rarely be lethal if applied to other areas. Most of the cases coming to the medical defense union were injuries that had at first seemed to be mild but the patient deteriorated and died due to intracranial haematoma which are often undiagnosed because the presence of a fracture is unsuspected or ignored and negligence may be alleged against the doctor. Unfortunately, even when the diagnosis is made the results of surgical intervention are not good, as a fatal outcome usually results in over half the cases operated on.[7]

This study assesses the epidemiology of craniofacial injuries trauma registered in Tanta University Hospital and treated according to injury pattern. Their mean age was 22.72 ± 16.78 years. The age group with the highest incidence in this study was the first decade of life, while Chiu et al. [8] found that it was 20–29 years group.

Children are uniquely susceptible to craniofacial trauma because of their greater cranial to body mass ratio.[9] However, the fraction of patients with poor neurologic outcome increases with age, reflecting a reduced injury tolerance and recovery in older patients.[10]

The male to female ratio in this study was 5.5:1 when compared with Chiu et al.[8] where the ratio was 2:1, while Lin et al.[11] reported a ratio of 3:1.

Road traffic accidents were the most common cause in this survey accounting for 54.12% of all accidents with high prevalence in third decade of life. Males showed high likelihood of road traffic accidents.

The result of our study coincides with several studies reported by, Zochariades et al.[12], Anwar et al.[13], Gopalakrishna et al.[14,4], Iida et al.[15], and Yoffe et al.[16] showing that road traffic accidents were the most common cause of craniofacial injuries. Although the installation of airbags in motor vehicles has reduced the morbidity and the mortality following motor vehicle accidents, new types of facial trauma are attributable to airbag deployment.[17,3]

In contrast, the developed countries showed a striking reduction in the broad category of road traffic accidents and the increasing influence of personal violence.[18] Israr and Shah[19] from Sheffield UK showed that the etiology of craniofacial trauma depend on social, cultural and geographic setup.

The high number of craniofacial injuries due to road traffic accidents in our county is due to the lack of road sense among the road users, over speeding, under age drivers, slow moving vehicles on road like tractor trolley, bad condition of vehicles, over loading and bad condition of roads. In our study, large number of people was belonging to low socioeconomic group in this region of our country and they use public transport vehicles operated by illiter-

ate road sense drivers which leads to accidents, that is the main reason for high number of road traffic accidents cases.

Moreover, falls were the second common cause of injury in this survey accounting for 36.47% of all causes; it dominated in the first decade of life which is comparable to the previous studies of Cook and Row.[20] The boy: girl ratio of 2/1 differ in magnitude from other reports revealing boys to be more prone to trauma.[21,22]

In contrast to other reports as Lee et al.[23] where assaults were the second most common cause of injury, the percentage of persons injured during acts of violence was low with 9.41% in this database. People in the second and third decades of life are most prone to assaults.

The interpersonal violence is a common cause in most developed countries. It is due to the consumption of alcohol in these societies which leads to increased prevalence of violence, but as we live in a Muslim society where alcohol is prohibited socially and culturally, the incidence of violence is negligible which is reflected in our study. This agree with the results reported by Anwar[13] from Jordan which is a Muslim country too. Alcohol intake is usually a contributing factor to both assaults[24] and road traffic accident[25] in non-Muslim countries.

In our study, 75.69% sustained soft tissue injuries with a mean age of 19.30 years. Logistic regression analysis found that traffic accidents and assaults result frequently in this type of injury. While skull fractures and brain injuries frequently present in traffic accidents and fall. Another craniofacial study focusing on soft tissue injuries and bone fractures, revealed falls and assaults as principal etiologic factors.[26]

Nearly 40% of patients with craniofacial injuries sustained intracranial lesions with high incidence of brain injuries (73.33%). Traffic accidents accounted for the most frequent cause of injury in these patients. In our research on patients with intracranial hemorrhage (34.12%) were males much more numerous than females (4.7%). Furthermore, the mortality rate of intracranial hemorrhage among male patients was three times higher than that among female patients. This result may be explained by the fact that males are most often in charge of high-risk jobs, and this gives them a higher chance of being exposed to danger. Besides, most males are more active than females and also tend to enjoy adventures or exciting activities.[27]

An analysis of the head injury-related intracranial hemorrhages with age stratification shows that the age group from 21 to 30 years had the highest incidence, which was about 8.2% among all the patients with intracranial hemorrhages. The age in this range coincides with the adolescence–adult period. People in this age group are usually very energetic, showing a lack of an adequate coping system. Sometimes they prefer to release the pressure by way of excessively speedy riding or driving of the vehicles. Therefore, it is understandable why so many injuries occurred and caused the highest incidence of intracranial hemorrhages in this age group.[11] Among the causes of head trauma, we found that injuries caused by traffic had a higher incidence of intracranial hemorrhage (24.7%) than falls (11.76%), and this was also statistically significant.

Traumatic brain injury (TBI), according to the World Health Organization, is expected to surpass many diseases as the major cause of death and disability by the year 2020. With an estimated 10 million people affected annually by TBI, the burden of mortality and morbidity that this condition imposes on society, makes TBI a pressing public health and medical problem. The burden of Traumatic brain injury is manifest throughout the world, and is especially prominent in Low and Middle Income Countries which face a higher preponderance of risk factors for causes of Traumatic brain injury and have inadequately prepared health systems to address the associated health outcomes.[28]

Combined injuries are frequent in this study; 38.43% of the patients were presented with soft tissue injuries and skull fractures, 32.16% were skull fractures combined with brain injuries and about 25.49% were a combination of skull fractures, brain injuries and soft tissue injuries. Javouhey et al.[29] found that combinations of these injury categories were described among 37% of the patients who sustained multiple severe traumatic brain injuries. Nevertheless, Caroli et al.[30] showed that multiple injuries had the same prognosis as the corresponding single injury and that an intracerebral haematoma as a predominant injury was a predictor of bad outcome.

Operations were performed in 148 patients (58.04%) to evacuate haematomas and to elevate depressed bone fractures and this is comparable to Viano et al.[10] performed operation in 50% of their patients to evacuate haematoma and contused brain tissue.

There was no evidence of major variations in practice (surgical versus conservative management) between individual clinicians in this series. The clinical status of the patient (assessed by GCS) and the size of the EDH (small or large) appeared to be the driving variables that influenced decisions about operative management or conservative treatment.[27]

The rehabilitation needs of brain injured persons are significantly high and increasing from year to year. Developing countries face the major challenges of prevention, pre-hospital care and rehabilitation in their rapidly changing environments to reduce the burden of TBIs.

4. Conclusions

The results of this study show that road traffic accidents are the most common cause of craniofacial injuries in Tanta University Hospital. Older persons are more prone to skull fractures and brain injuries while, younger ones are more susceptible to soft tissue injuries. There is dire need to improve road conditions, strict enforcement of traffic rules including seat belt legislation and run campaign to aware road users about the road safety which will decrease the incidence of craniofacial injuries. It is necessary to emphasize the need for protective devices capable of avoiding not only neurological complications but also craniofacial fractures. Optimal care depends on neurosurgeons defining clear management policies for injuries of all severities so that other surgeons know which neurosurgical patients need care and how to deal with the others.

Conflict of Interest

None declared.

Funding

None declared.

Ethical Approval

This work obtained approval from the monthly meeting of forensic medicine and clinical toxicology especially for the ethical point.

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